

The Challenge of Reducing Energy Consumption in China's Industrial Sector

**Lynn Price
China Energy Group
Energy Analysis Department
Environmental Energy Technologies Division
Lawrence Berkeley National Laboratory**

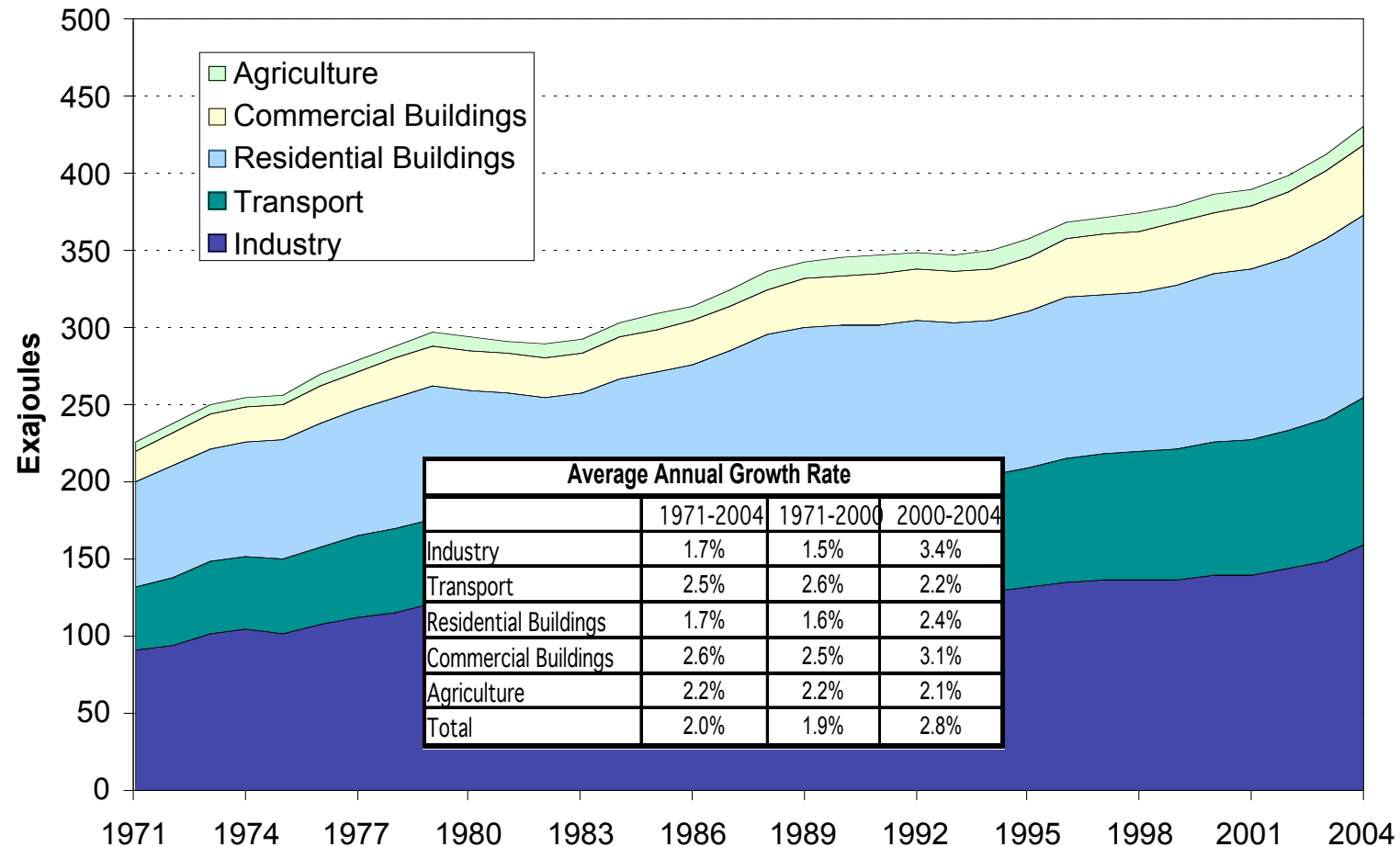


Today's Presentation

- Global Industrial Sector Energy Use
- The Challenge: Energy Use Trends in China
- Addressing the Challenge
 - Energy Efficiency Agreement Pilot Program
 - Top-1000 Energy-Consuming Enterprises Program
 - Focus on Cement Industry
- Initial Results and Next Steps

Global Industrial Sector Energy Use

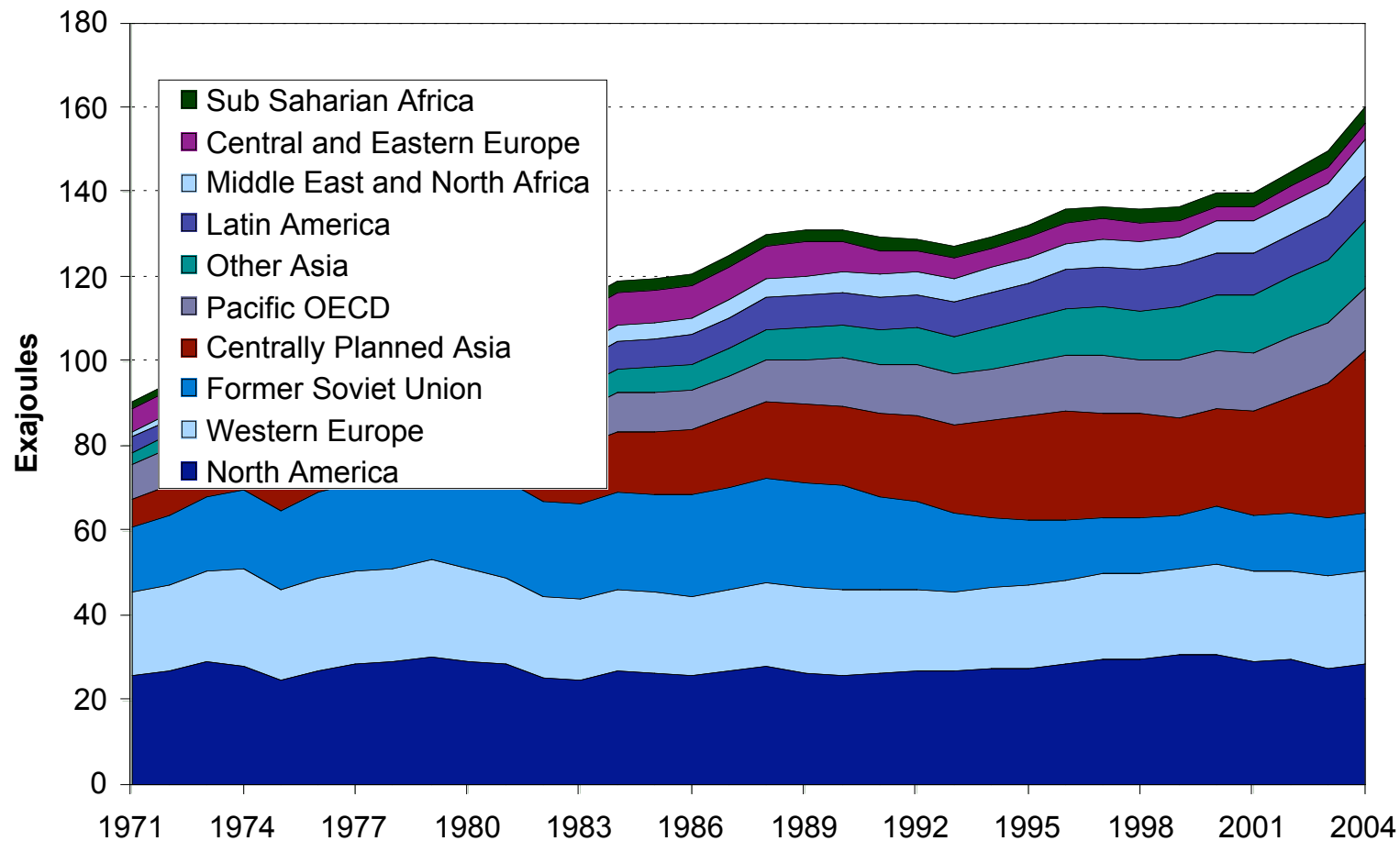
Global Primary Energy Consumption 1971-2004



Source: de la Rue du Can, S. and Price, L., 2008. "Sectoral Trends in Global Energy Use and Greenhouse Gas Emissions," *Energy Policy*, 36(4): 1386-1403

Introduction: Industrial Sector Energy Use

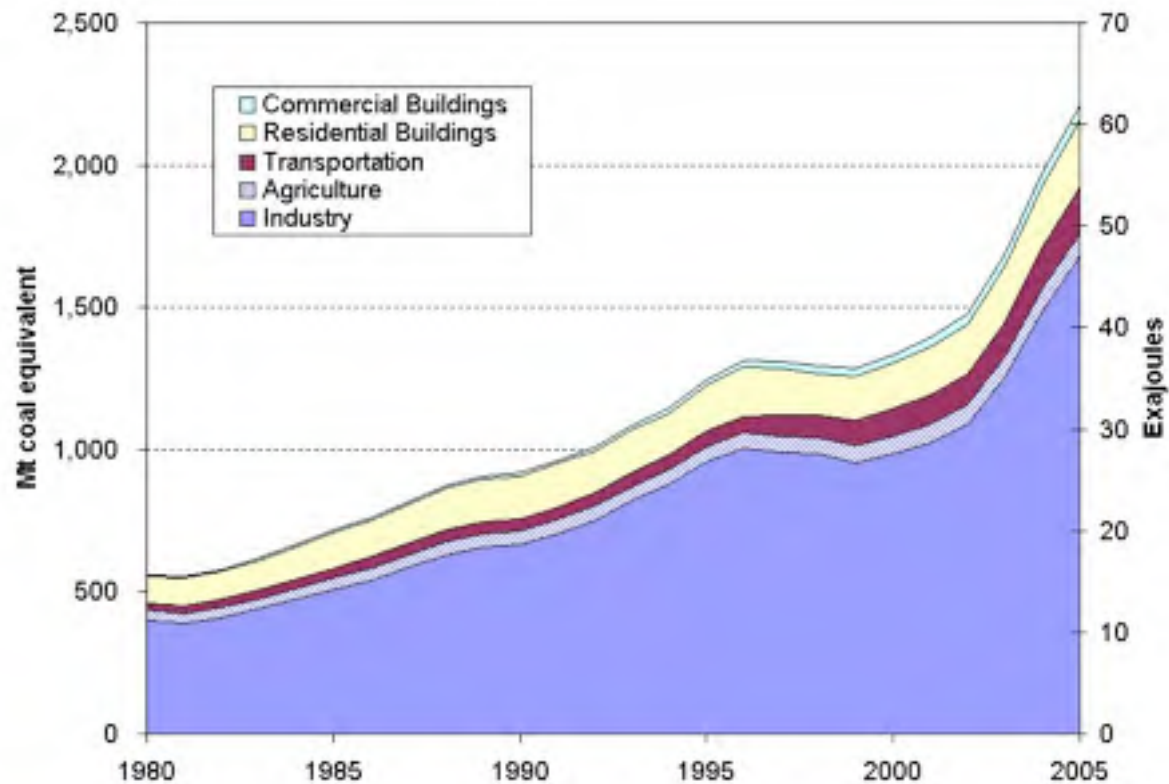
Industrial Primary Energy Consumption by Region 1971-2004



Source: de la Rue du Can, S. and Price, L., 2008. "Sectoral Trends in Global Energy Use and Greenhouse Gas Emissions," *Energy Policy*, 36(4): 1386-1403

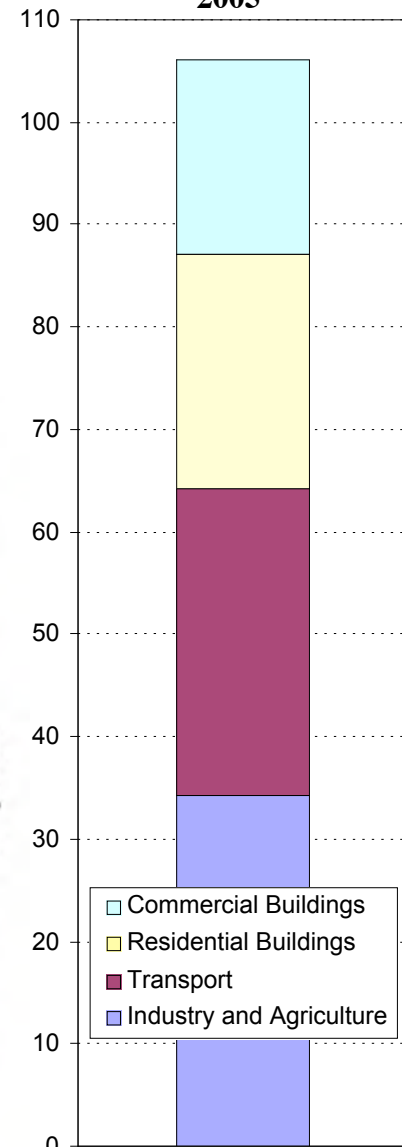
The Challenge: Trends in Energy Use in China

China: Primary Energy Use by Sector
1980-2005



Note: Mtce >> EJ = 0.0293; EJ >> Quads = 0.9478

US: Primary Energy Use by Sector
2005



Source: EIA, 2008. *Annual Energy Outlook*.

Addressing the Challenge: Approach

- LBNL's China Energy Group has a long-standing, successful track record in China, based on the following approach:
 - Work with high-caliber China-based partner organization(s)
 - Convene experts, discuss issues from China's point of view
 - Conduct research on existing situation in China
 - Identify international best practices
 - Distill and disseminate information
 - Communicate with partners/experts
 - Focus on policies
 - Develop tools as necessary, provide training
 - Start with smaller pilot projects, scale-up after lessons are learned
 - Be willing to have things done to fit “the Chinese conditions”

Energy Efficiency Agreement Pilot Program

- Industrial energy efficiency policy project launched in 1999
- LBNL:
 - Teamed with China Energy Conservation Association (CECA)
 - Convened experts from Energy Research Institute, Tsinghua University, and others
 - Undertook industrial policy research
 - Organized international workshop on industrial energy efficiency policies and programs
- Voluntary agreement programs chosen as model policy for pilot
- China's government launched policy pilot using "energy efficiency agreements" with 2 steel mills in Shandong Province



Energy Efficiency Agreement Pilot Program

- LBNL:
 - Led study tour to UK and Netherlands
 - Developed benchmarking and energy-saving tool (BEST) for steel
 - Trained CECA on the use of BEST-Steel to work with steel mills to determine potential and negotiate targets
- Agreements signed April 24, 2003
- Steel mills committed to:
 - Energy intensity targets by 2005
 - Implement energy-efficiency technologies and management practices
 - Report energy use and other indicators annually
- Shandong Province Economic and Trade Commission committed to provide:
 - Assistance in obtaining loans for energy-efficient technologies
 - Government-backed technical experts
 - Positive publicity for steel mills



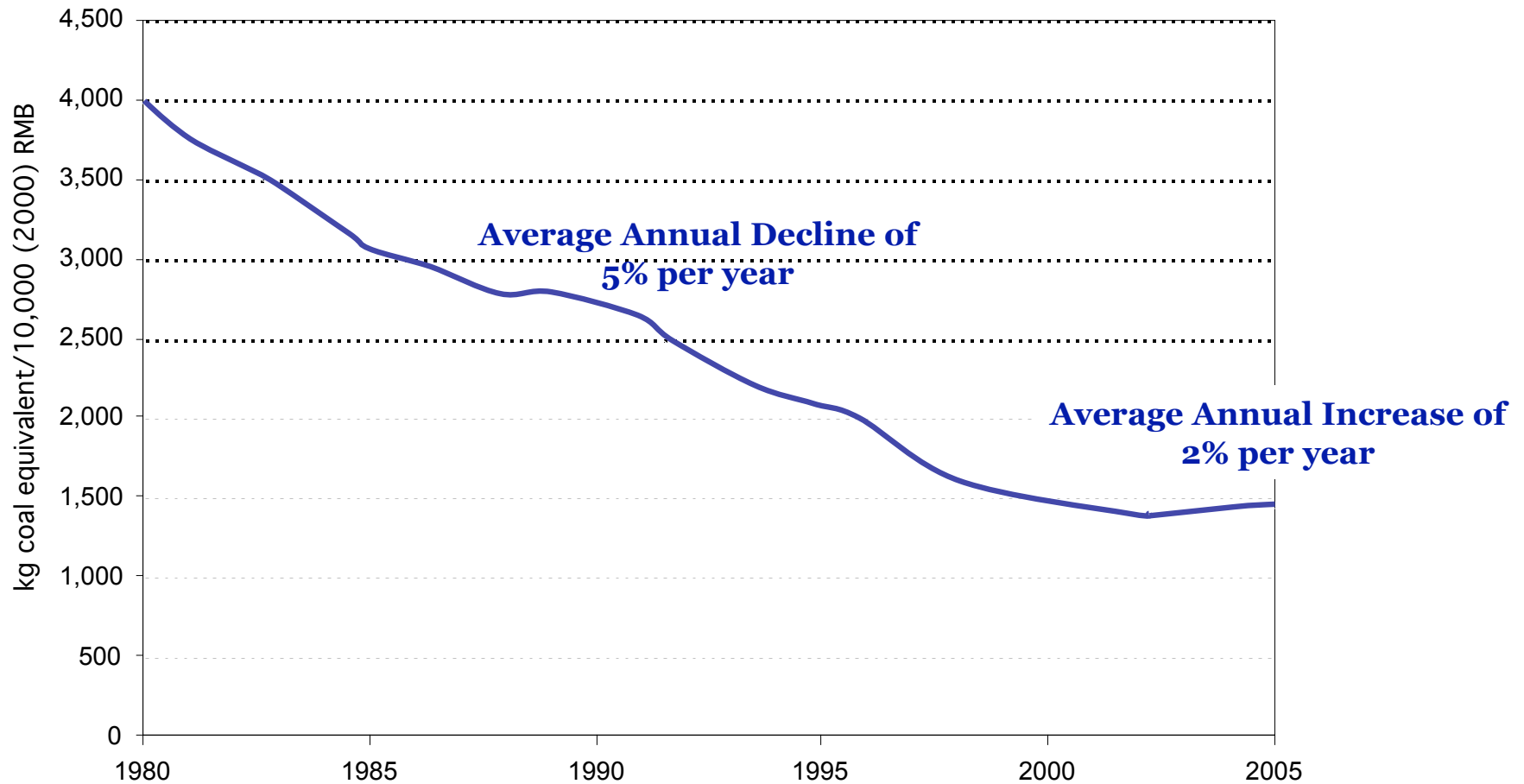
Energy Efficiency Agreement Pilot Program

- 13 performance indicators monitored, including:
 - Energy consumption per ton steel
 - Total energy savings
 - Cost savings from reduction in energy use
 - CO₂ emissions reductions
- Jigang saved 292,000 tce (8.6 PJ, 8.1 Tbtu) and reduced energy consumption per ton of steel by 9.5%
- Laigang saved 130,000 tce (3.8 PJ, 3.6 Tbtu) and reduced its energy consumption per ton of steel by 9%
- Both plants:
 - Implemented strong energy management programs
 - Established monitoring and reporting protocols
 - Enjoyed extensive positive publicity
- Pilot considered a success and a model for national program



Energy Use in China: Historic Trends

Economic Energy Intensity (E/GDP) Declined Steadily From 1980 to 2002



Establishment of 20% E/GDP Target

- November 2005
 - Premier Wen Jiabao told the Plenary of the Communist Party: “Energy use per unit of GDP must be reduced by 20% from 2005 to 2010”
- March 2006
 - Statement reiterated by the National Peoples Congress
- China’s 11th Five Year Plan (2005-2010): outlined goal of reducing energy consumption per unit of GDP by 20% between 2005 and 2010
- Depending upon the GDP growth rate - 2010 energy savings need to be around 700 Mtce (21 EJ, 19.5 Quads)
- Targets were allocated to each Province

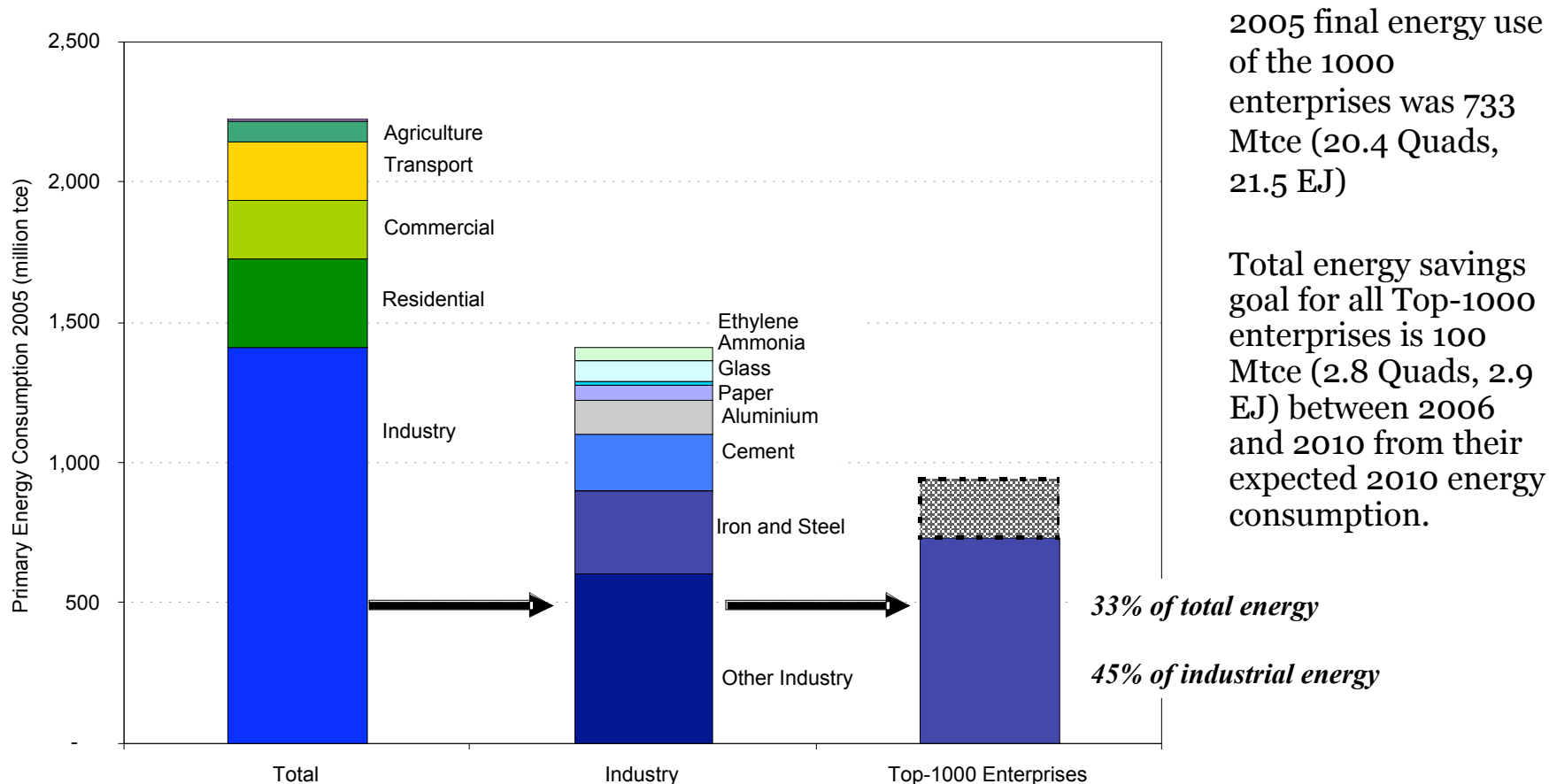


Top-1000 Energy-Consuming Enterprise Program

- Announced – April 2006
- Energy-saving agreements were signed with the 1000 largest energy-consuming enterprises
- Enterprises commit to:
 - Formulate energy conservation plans
 - Conduct energy audits and benchmarking
 - Establish monthly energy use reporting system
 - Adopt comprehensive energy conservation measures
 - Submit an “Enterprise Energy Usage Annual Report”
- Provincial authorities:
 - Signed a contract with the National Development and Reform Commission outlining the Top-1000 program savings targets for the enterprises in its province
 - Signed a contract with each enterprise that stipulates the amount of energy they must save by 2010
 - Track, supervise, and monitoring the energy-saving activities of the enterprises
 - Improve monitoring of the enterprises through audits and sampling



Top-1000 Enterprises Represent a Significant Share of China's Energy Use



Note: Top-1000 program energy consumption is typically reported in final energy units (dark blue box). The shaded area provides the Mtce equivalent of electricity generation, transmission, and distribution losses so that the Top-1000 program can be compared in primary energy terms with the other two bars. Industry sub-sector breakdown based on LBNL LEAP model, not Chinese statistics.

Top-1000 Energy-Consuming Enterprise Program

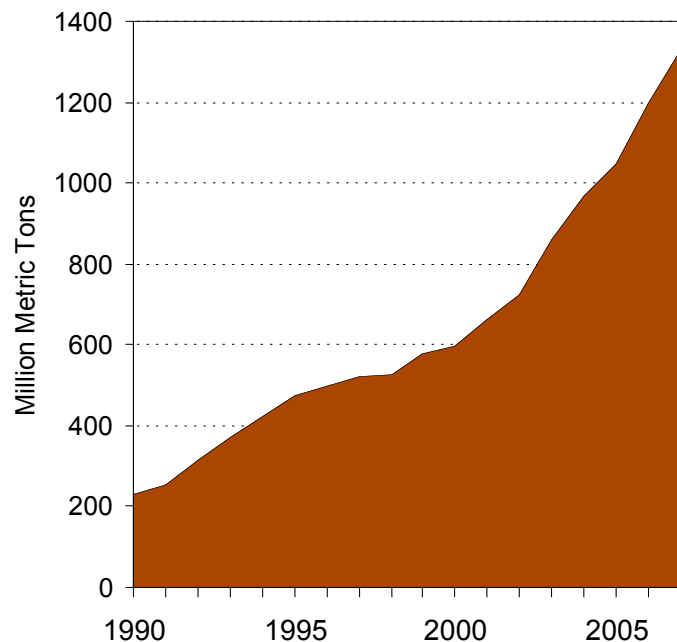
- LBNL technical assistance:
 - Collaboration with Energy Research Institute and top industrial institutes and associations
 - Energy efficiency guidebooks for iron and steel, cement, and petroleum refining
 - Report on international best practice energy consumption for key industrial sectors
 - Report and workshop on international best practice industrial policies and programs
 - Workshop on benchmarking for the industrial sector
 - Development of a benchmarking and energy saving (BEST) tool for the Chinese cement industry
 - Training in use of BEST-Cement for China



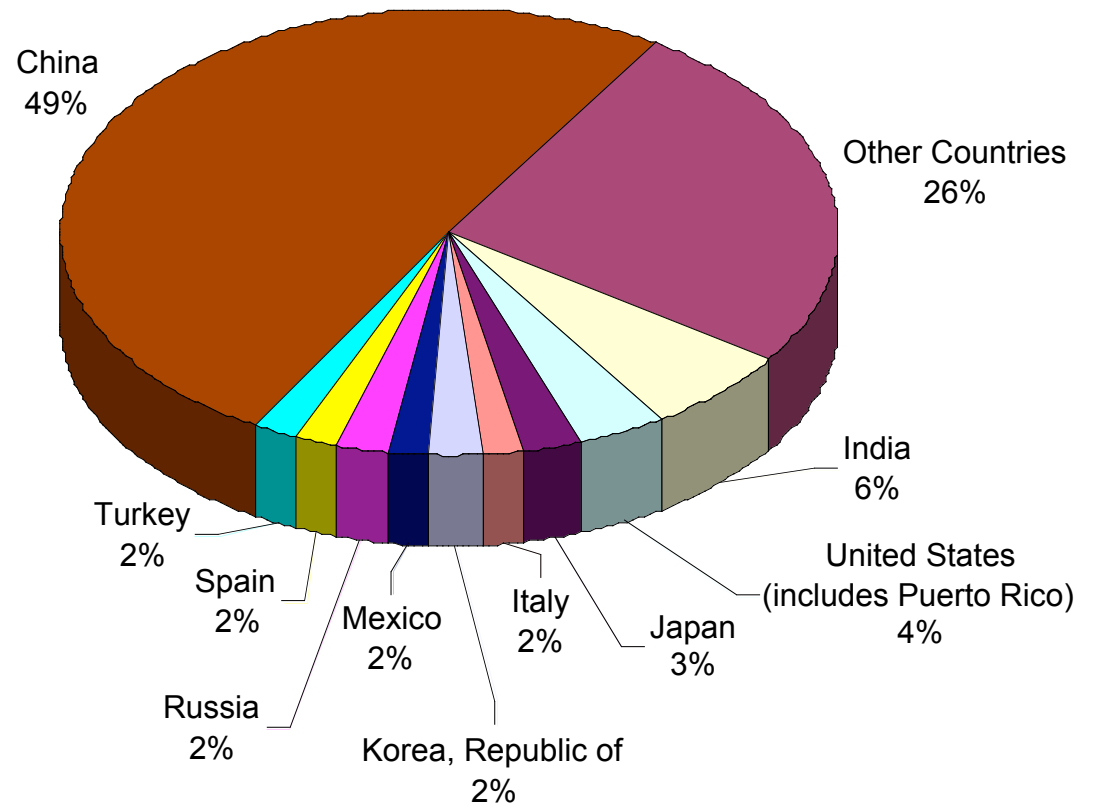
China

World's Largest Producer of Cement

China's Cement Production
1990-2007



World Cement Production 2007



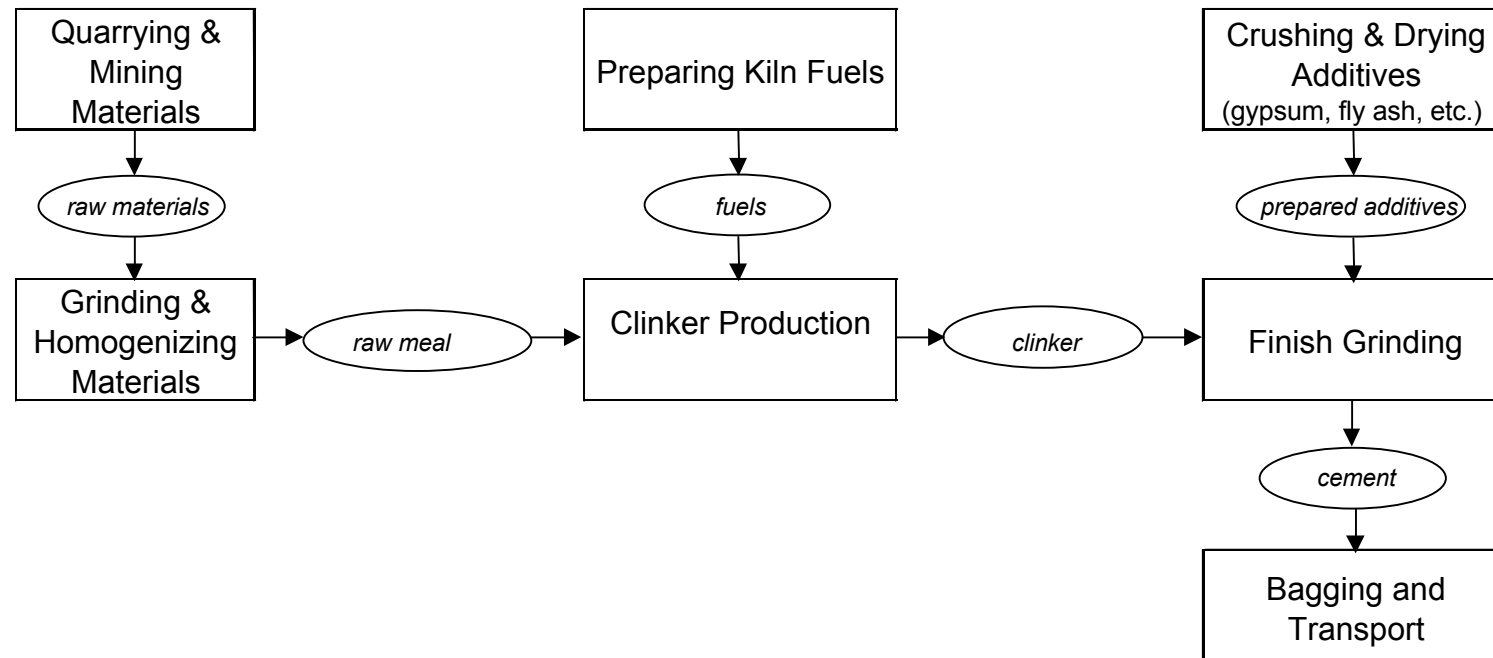
Cement Manufacturing



Raw Material Preparation (1-3)

Clinker Making (4-5)

Finishing (6-9)



Cement Benchmarking Energy Intensity Index (EII)

$$EII = 100 \cdot \frac{\sum_{i=1}^n P_i \cdot EI_i}{\sum_{i=1}^n P_i \cdot EI_{i,BP}} = 100 \cdot \frac{E_{tot}}{\sum_{i=1}^n P_i \cdot EI_{i,BP}}$$

EII	= energy intensity index
n	= number of processes to be aggregated
EI_i	= actual energy intensity for process i
$EI_{i,BP}$	= best practice energy intensity for process i
P_i	= production quantity for process i
E_{tot}	= total actual energy consumption for all processes

BEST-Cement for China

- Collaborators: Energy Research Institute, China Building Materials Academy, China Cement Association, and others
- Benchmarks a cement plant (or kiln) to world and Chinese best practice – by process step
- Provides an extensive menu of energy-efficiency or carbon emission reduction measures that can be implemented
- Provides information on each measure
 - Description
 - Typical energy savings per ton product
 - Cost of implementation
 - Simple payback period



BEST-Cement Demonstration



BEST-Cement for China

Current Status

- Beta-tested tool with two cement plants in China in April 2008
- Revised tool posted on BEST-Cement for China website: <http://china.lbl.gov/best-cement-china>
- 2-day hands-on training sessions in July 2008
 - Shandong Province: 29 people from 17 cement plants
 - Shanxi Province: 60 people from 55 cement plants
 - Hebei Province: 51 people from 37 cement plants
- Training workshops in 1-2 additional Provinces planned for October 2008

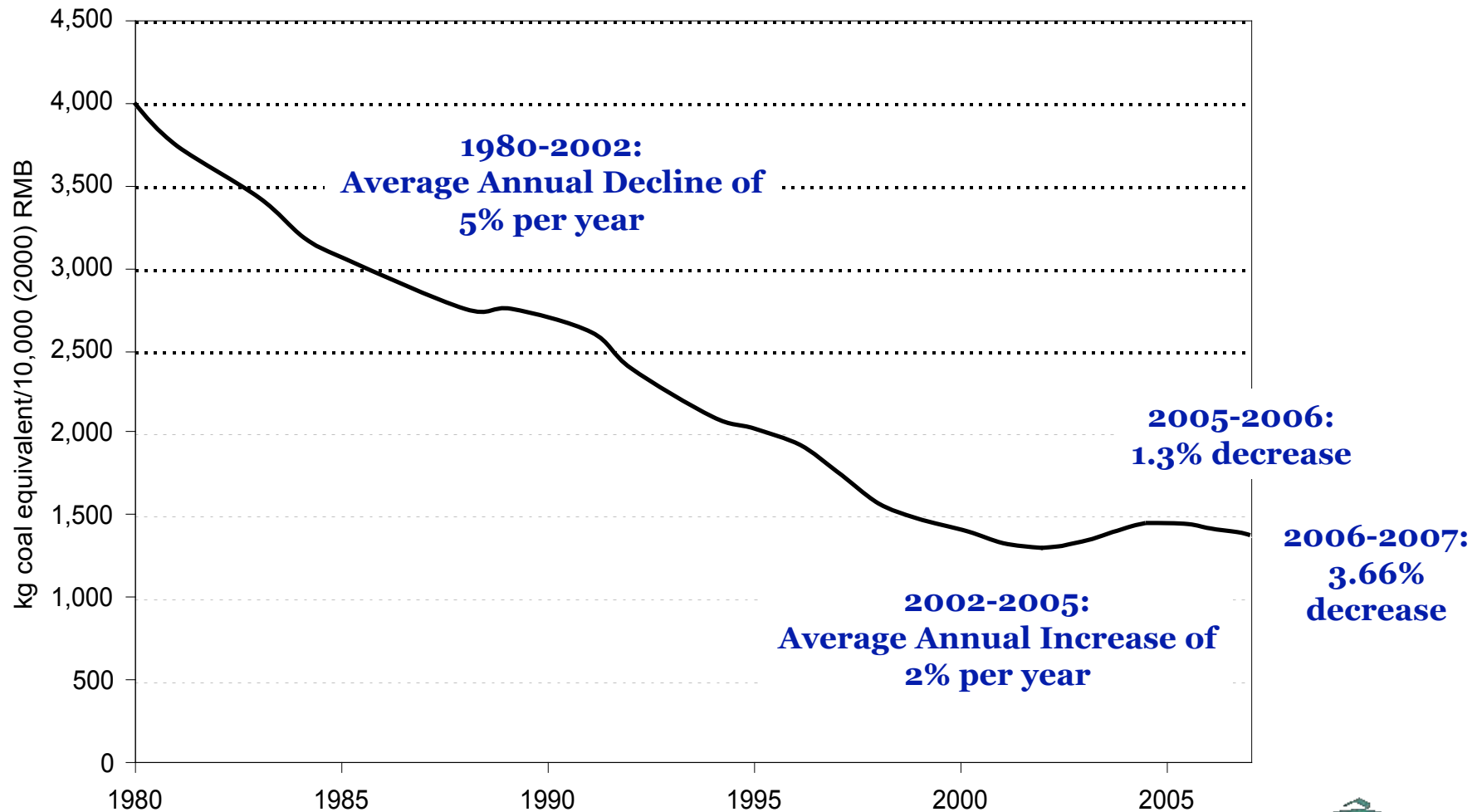


Initial Results of Top-1000 Program

- Top-1000 Enterprises Energy Use Report - 2007
 - 954 enterprises submitted statistics
 - 942 enterprises submitted energy audit reports
- Top-1000 Enterprises saved 20 Mtce (0.6 EJ, 0.56 Quads) in 2006
- Calculated emissions factor of 3.04 tCO₂/tce
- Developed two scenarios:
 - 2010 Target Achieved
 - 100 Mtce (2.9 EJ, 2.8 Quads) = ~300 MtCO₂
 - Current Trends
 - 148 Mtce (4.3 EJ, 4.1 Quads) = ~450 MtCO₂
- Recently reported 2007 annual savings – 38 Mtce (1.1 EJ, 1 Quad)

Top-1000 Program on track to deliver 10-20% of the energy savings needed to meet the 2010 20% E/GDP goal

Energy Use in China: Historic Trends



Next Steps

- Continue to support the Top-1000 program
 - Analytical support: evaluate 2007 report, analysis of the performance of the Top-1000 enterprises compared to other enterprises (with ERI, NBS, Brandeis, and Penn)
 - Development of additional energy efficiency guidebooks, benchmarking assistance
- Additional BEST-Cement training workshops in two provinces, follow-up activities
- World Bank project focused on Hebei and Shandong Province
 - Use BEST-Cement to evaluate energy-efficiency options for large cement manufacturers in each province
 - Establish policies/programs to disseminate \$200 million in World Bank energy efficiency funding
- Asia Pacific Partnership project – focused on 42 largest cement plants/companies in China, representing 30% of all cement production
 - Aligning BEST-Cement, selected DOE energy auditing tools, and WRI/WBCSD GHG Protocol tool for cement industry
 - Conducting energy audits
 - Evaluating energy-saving and emission reduction potentials
 - Pilot project on use of alternative fuels

Lessons Learned

- China's industrial sector is complex
 - Many industries and a wide array of technologies
 - Facilities range from old, backward to new, state-of-the art
- Production is often highest priority
 - Plant managers don't have time to worry about saving energy or the environment
 - Government must intervene to raise the priority of energy and the environment
- Central government lacks energy efficiency capacity
- Enormous opportunity
 - strong government support for energy efficiency
 - new policies and programs are being introduced rapidly
- Many, many challenges: lack of technologies, lack of awareness of energy-efficiency options, lack of incentives and regulations, differences in cultures, language, energy units, etc.
- Essential to select the right partner(s), undertake trials with pilots, scale-up and replicate
- Results can be extremely rewarding: potentially large pay-off for any success, technical assistance efforts are greatly appreciated

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China Energy Group
Lawrence Berkeley National Laboratory
1 Cyclotron Road, 90R4000
Berkeley, CA 94720
<http://china.lbl.gov>